Heraeus

Media Briefing

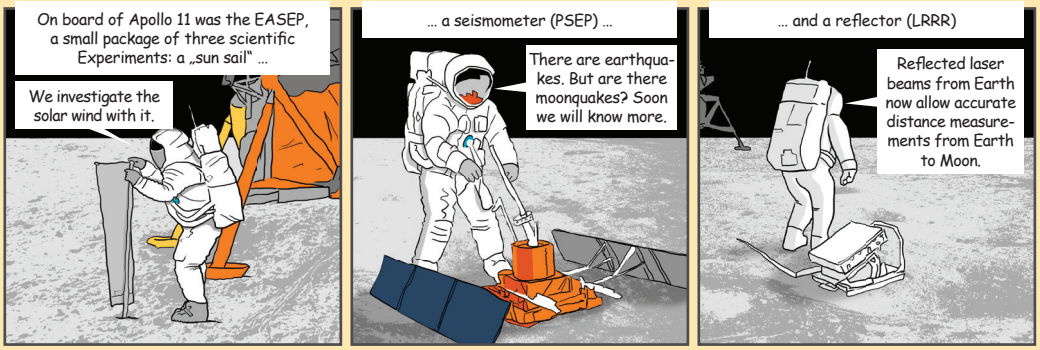
50th anniversary of the moon landing – Heraeus and the Apollo 11 mission

What is the connection between the moon landing and this technology group from Hanau?

Heraeus products perform important tasks on Earth: in cars, cell phones, pacemakers, computers, solar cells, internet fiber optic cables, and airbags. But outer space is not new territory for Heraeus. For example, the aerospace industry uses special space catalysts to break down hydrazine in rocket fuel in engines for probes and satellites. Perfect cubes of precious metals are helping to prove Albert Einstein's theory of relativity through experiments in outer space. Heraeus has now been on the moon for more than 50 years – thanks to its high-tech quartz glass materials.

50th anniversary of the moon landing – a laser reflector celebrates an anniversary

When the American astronaut Neil Armstrong became the first person to set foot on the moon on July 20, 1969, this "giant leap for mankind" was also a milestone for science. The legendary Apollo 11 mission had the Early Apollo Surface Experiments Package (EASEP) and a reflector (LRRR), which included a quartz glass laser reflector that Buzz Aldrin set up on the moon.



Still in operation today, the reflector is used to measure the exact distance between Earth and the moon (on average, about 384,000 kilometers). It consists of an array of 100 triple prisms made of quartz glass–supplied by Heraeus.

NASA selected this material because of its extraordinary long-term resistance to ionizing radiation and high optical homogeneity. To take the measurements, a high-intensity infrared laser beam is directed at the retro reflectors and then the travel time of the light is measured in what's known as lunar laser ranging. The reflectors send the light back exactly in the direction from which it came, similar to a bicycle reflector.

The retro reflectors are still operating successfully after more than 50 years. Two more laser reflectors were placed on the moon in 1971, as part of the Apollo 14 and Apollo 15 missions, for the purpose of exactly measuring the moon's variable rotation. This data supplies important information about the moon's gravitational field and tidal deformation. Soon the next generation of retro reflectors, with triple reflectors, will be placed on the surface of the moon, and these reflectors will use Heraeus quartz glass as well.

Materials such as quartz glass are subject to extreme conditions in outer space, the most significant of which are the great differences in temperature, harsh UV rays from the sun, and high-energy radiation from the depths of the cosmos. Heraeus regularly uses these special orders and technological challenges to continue perfecting its own expertise in manufacturing precision, high-performance quartz glass, and these experiments help Heraeus improve its understanding of the material.

Why quartz glass? What is it actually?

Quartz glass has been used for a multitude of purposes for more than 120 years. Heraeus is one of the world's few specialists that produces this material. In 1899, former Heraeus head researcher Dr. Richard Küch (1860–1915) was the first person to melt rock crystal at about 2000°C by using an oxyhydrogen blowpipe (oxygen-hydrogen flame).

The outcome of his experiment was a new material with extraordinary properties: quartz glass. Heraeus Quarzglas is one of the technological leaders and materials specialists for the manufacture and processing of highly pure quartz glass for the semiconductor, telecommunications, optical, chemical and lamp industries.


Image Science and Analysis Laboratory, NASA-Johnson Space Center.

Although extremely difficult to differentiate from normal glass visibly, quartz glass possesses such singular properties as chemical, temperature, and radiation resistance, as well as exceptionally high optical transparency in the visible and invisible (ultraviolet and infrared) light spectrum. Synthetic quartz glass is comprised at least 99.9999% of silicon and oxygen (SiO_2) and is characterized by resistance to thermal shock.Unlike normal glass, it can be cooled (below -200°C) and heated (over 1000°C) very rapidly without shattering. Synthetic quartz glass is considered one of the purest materials that can be synthesized.

It contains trace elements in very small concentrations, often only in the parts-per-billion (ppb) range. Its extreme resistance to ionizing radiation is particularly crucial for aerospace applications. Synthetic quartz glass is considered one of the purest materials that can be synthesized. It contains trace elements in very small concentrations, often only in the parts per billion (ppb) range. Quartz glass is so pure that you could see through a 100 m thick slab of it as if it were a piece of thin window glass.

Heraeus first produced quartz-glass laboratory equipment for the chemical industry. This was followed by applications for optics (optical quartz glass), temperature measurement (platinum resistance thermometer), and lamps (such as the original Hanau Höhensonne® sun lamp). Thanks to its high quality, starting in the 1950s, optical quartz glass from Heraeus conquered more and more challenging areas of application in the fields of astrophysics, aerospace engineering, microelectronics, optical telecommunications, and the semiconductor industry. In 1955, Heraeus produced synthetic quartz glass for the first time. Suprasil-brand synthetic quartz glass established itself in such fields as aerospace engineering, for use as mirror prisms and lens and window materials.

Nowadays high-purity quartz glass is indispensable in the production of optic fibers for the telecommunications industry, and high-speed internet would be impossible without quartz glass.

Current space projects involving Heraeus

Materials used in outer space have to be able to withstand the extreme conditions when leaving the Earth's atmosphere into space and for at least the duration of the flight. In space travel applications, this usually means a period of several years or even decades. Especially in outer space, materials are exposed to high doses of ionizing radiation, and they must not show any significant signs of age or deterioration.

Quartz glass is ideally suited to the conditions in outer space, which is why Heraeus quartz glass has been used in a variety of space projects for many years now.

Gravity Probe B:

NASA's Gravity Probe B project posed a particular challenge for synthetic quartz glass. In 2005, the Gravity Probe B research satellite collected important measurement data over 18 months in orbit. The research project's objective was to prove an aspect of Albert Einstein's general theory of relativity. According to NASA, the data analysis that was concluded in 2011 actually confirms Einstein's theoretical considerations. The core element of the Gravity Probe B satellite consisted of a 53 cm-long quartz glass block connected to a quartz glass telescope and containing four gyroscopes. These ping-pong ball-sized spheres rotating at 5,000 to 10,000 revolutions per minute were considered the roundest objects in the world to date and were made of Heraeus' high-purity Homosil quartz glass coated with superconductive niobium. The outstanding thermal properties of Heraeus quartz glass played a part in the project's success.

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Project GAIA:

The goal of this mission is to create the largest and most precise three-dimensional map of the Milky Way. In spring 2009, Heraeus delivered precursor materials for prisms and lenses for the Gaia astrometry satellite. During its space mission, the Gaia satellite will determine the positions, distances, and movements of approximately one billion stars. These astral measurements will help explain the origin and development of the Milky Way. Begun on December 19, 2013, the mission was originally scheduled to end on July 25, 2019, but a preliminary extension has pushed out the end date into late 2022. Heraeus Quarzglas has made it possible to create the largest and most detailed maps of our Milky Way.

Gold and platinum also at work in discoveries in space

Heraeus has contributed to highly precise experiments in space also. As part of the joint international LISA (Laser Interferometer Space Antenna) project, the European Space Agency (ESA) is searching for additional evidence of the gravitational waves that Einstein posited in his general theory of relativity. On board the satellite are perfectly identical cubes with an edge length of 50 millimeters made of a special gold and platinum alloy from Heraeus. Despite their small scale, these precious proof masses will allow researchers to measure minute changes in distance likewise caused by gravitational waves. In June 2016 ESA released the results of the first two months of the experiment, which showed that the measurement accuracy exceeded requirements five times over.

For more information about Heraeus and outer space, discover: www.apollo-11.com

Are you interested in reporting on Heraeus' role in the Apollo 11 program? Please feel free to contact us

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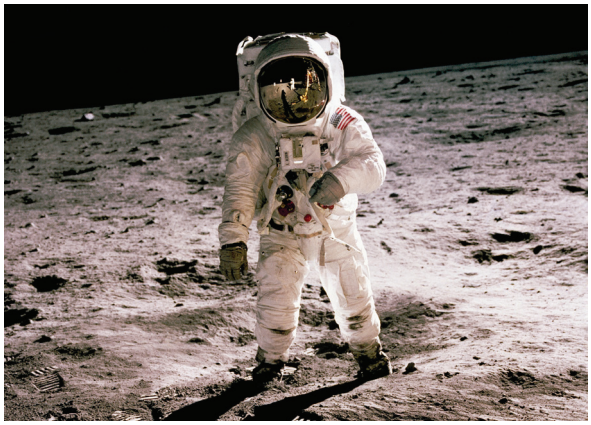

About Heraeus

A globally leading technology group, Heraeus is headquartered in Hanau, Germany. Founded in 1851, it is a family-owned portfolio company which traces its roots back to a pharmacy opened by the family in 1660. Today, Heraeus combines businesses in the environmental, energy, electronics, health, mobility and industrial applications sectors. In the 2017 financial year, Heraeus generated revenues of €21.8 billion. With approximately 13.000 employees in 40 countries, the FORTUNE Global 500-listed company holds a leading position in its global markets. Heraeus is one of the top 10 family-owned companies in Germany. With technical expertise, a commitment to excellence, a focus on innovation and entrepreneurial leadership, we are constantly striving to improve our performance. We create high-quality solutions for our clients and strengthen their long-term competitiveness by combining unique material expertise with leadership in technology